

A survey for Black-bellied Tern *Sterna acuticauda* and other riverine birds on the Jamuna and Padma rivers in Bangladesh

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Owing to disturbance, degradation and destruction of riverine habitats, the Black-bellied Tern *Sterna acuticauda* has become extremely rare in Bangladesh. A casual sighting of a pair in breeding plumage on the Jamuna River in January 2011 generated hope that the species might still breed. This paper sets out the findings of surveys carried out between December 2011 and April 2012 to determine the current status of the Black-bellied Tern and other riverine birds along the Jamuna and upper Padma rivers. Potentially suitable and undisturbed sandbanks away from the main channels were identified from satellite images. In addition, more intensive searches were targeted on the locations of recent and historical sightings of Black-bellied Tern. Semi-structured interviews were carried out with local fishermen and villagers on the occurrence of Black-bellied Tern and potential threats to riverine birds such as hunting and egg collection. A total of 75 species of birds was recorded during the survey: 69 on the Jamuna and 49 on the Padma rivers. Although no evidence of continued breeding (or even presence) of Black-bellied Tern was found, the extent of potentially suitable habitat suggests that its presence in small numbers cannot be entirely ruled out. As a consequence a number of recommendations are made which if implemented would benefit not only Black-bellied Tern but also the remaining riverine species in Bangladesh.

INTRODUCTION

Human impact on riverine biodiversity is more apparent in Asia than any other part of the world. Flow regulation, construction of large dams, flood control, over-harvesting of fish, pollution and conversion of riverine wetlands to agriculture are common threats to many Asian rivers (Dudgeon 2000, 2002). As a result of this ongoing degradation of riverine ecosystems some taxa have been gravely affected, especially riverine birds. Furthermore freshwater turtles are highly endangered, and over-harvesting has severely impacted fish—an effect that is exacerbated by pollution and flow regulation (Dudgeon 2002). In the dynamics of erosion and accretion in the rivers of Bangladesh, the sandbars emerging as islands within the river channel, or as attached land to the riverbanks, often create new opportunities to establish settlements and pursue agricultural activities on them. Once vegetated, such lands are commonly called chars in Bangladesh.

Bangladesh is a riverine country with numerous small rivers throughout it and three major rivers: Padma, Meghna and Jamuna. Like several other riverine species the Black-bellied Tern *Sterna acuticauda* was once common along the large river systems of Bangladesh including a now incredible record of 98 from Sirajganj in 1995 (P. Thompson *in litt.*). However, owing to large-scale destruction of riverine habitats throughout its range, the species has become extremely rare in Bangladesh and elsewhere. It was uplisted in 2012 from Near Threatened to Endangered due to a rapid and continuous decline over the last three decades, leading it to become almost extinct in a large part of its range. Loss of habitat

through agricultural conversion, river flooding and unsustainable development along large rivers, egg collection, disturbance and reduction in food supplies as a result of overfishing are known threats to this species (BirdLife International 2014a).

Although the Black-bellied Tern has a wide range, it is suspected that the global population is perhaps considerably fewer than 10,000 mature individuals. The species is now almost extinct in South-East Asia; very rare in southern China; fairly common in north Sind and Punjab in Pakistan; locally fairly common, but with evidence of local declines, in India; once locally fairly common but now a maximum population of 20 estimated in 2011 in Nepal; of uncertain status in Myanmar with none recorded during recent surveys; very rare and probably extinct as breeding species in Thailand; very rarely recorded today in Laos, although large numbers formerly bred along the Mekong channel; probably extinct in Cambodia, although formerly fairly common along the Mekong; probably extinct in Vietnam, although formerly recorded regularly (BirdLife International 2014a).

Apparently the only known stronghold of this species is National Chambal Sanctuary in India, but even here its status is precarious with recent counts between 2003 and 2010 varying from 24 to 64 (Rahmani 2012). Thorough surveys are needed to determine its current status and distribution in Bangladesh, Myanmar, Nepal and South-East Asia.

An opportunistic sighting of a pair of Black-bellied Tern in breeding plumage by A. B. M. S. Alam in January 2011 on the banks of the Jamuna River near Sariakandi, Bogra district, Bangladesh, generated hope that the species might still breed on the remote

Table 1. Sites surveyed along Jamuna (J) and Padma (P) rivers.

Stretch	J1	J1	J2	J3	J3	J4	J5	J6	J6	J7	P1	P2	P3	P4
Stretch length (km)	41	41	45	29.5	29.5	44	29.5	20	20	17	27	35	32.5	8.5
Date	28/12/2011	05/02/2012	29/12/2011	30/12/2011	22/04/2012	0/01/2012	02/1/2012	04/1/2012	28/03/2012	06/02/2012	06/02/2012	07/02/2012	08/02/2012	16/04/2012
from (local name)	Nagarbarighat	Nagarbarighat	Belkuchia	Dhunat	Dhunat	Sariakandi	Gabindaganj	Gaibanda	Gaibanda	Nagarbarighat	Aricha ghat	Pangsha	Kushitia	Rajshahi
to (local name)	Belkuchia	Belkuchia	Dhunat	Sariakandi	Sariakandi	Gabindaganj	Gaibanda	Bahadurabad	Bahadurabad	Aricha ghat	Pangsha	Kushitia	Lalpur	Rajshahi
from (coordinates)	23.569°N 89.395°E	23.569°N 89.395°E	24.169°N 89.456°E	24.397°N 89.392°E	24.397°N 89.392°E	24.547°N 89.344°E	25.095°N 89.371°E	25.233°N 89.383°E	25.233°N 89.383°E	23.569°N 89.395°E	23.473°N 89.436°E	23.504°N 89.303°E	23.556°N 89.099°E	24.208°N 88.390°E
to (coordinates)	24.169°N 89.561°E	24.169°N 89.456°E	24.397°N 89.392°E	24.545°N 89.344°E	24.545°N 89.344°E	25.095°N 89.371°E	25.233°N 89.383°E	25.341°N 89.409°E	25.341°N 89.409°E	23.483°N 89.462°E	23.504°N 89.303°E	23.556°N 89.099°E	24.095°N 89.003°E	24.195°N 88.378°E

sandbanks of the Jamuna and upper Padma river systems. This paper sets out the findings of riverine bird surveys carried out in these areas between December 2011 and April 2012. The objectives of the survey were: (1) to determine the current status of the Black-bellied Tern along the Jamuna and upper Padma rivers in Bangladesh; (2) to identify nesting sites in Bangladesh (if any); (3) to assess potential threats to the Black-bellied Tern; (4) to recommend future conservation measures; and (5) to determine the current status of other riverine birds along the Jamuna and upper Padma rivers.

METHODS

Study area and survey techniques

The survey was conducted on the Jamuna and Padma rivers, the two largest river systems in Bangladesh, between December 2011 and April 2012. The Black-bellied Tern was regularly sighted in the 1990s along these two rivers (Sykes 2010). The Jamuna River is the main channel of the Brahmaputra River when it flows south out of India into Bangladesh; it is 205 km long, ending at Goalundo Ghat where it joins the Padma River. Its width varies from 3 to 18 km, but the average is about 10 km. The Padma River is the downstream section of the Ganga, 120 km long and 4–8 km wide (Banglapedia 2006).

In the absence of a detailed habitat map of the rivers, specific survey locations in the study area—potentially suitable and undisturbed sandbanks and chars away from the main channels—were identified from satellite images freely available from Google Earth. In addition, more intensive searches for Black-bellied Tern were targeted on the locations of recent and historical sightings.

A total of 302 km of waterways, 199 km on the Jamuna and 103 km on the Padma, was surveyed from a slowly moving motorboat. Additionally, undisturbed sandbars not entirely visible from the boat were investigated on foot, and visits in December 2011, and March–April 2012 were made to sites such as Sirajganj and Sariakandi on the Jamuna and Kushtia on the Padma where *Sterna* sp. were seen recently or known historically. A minimum of three observers undertook these surveys. While cruising the rivers, surveyors observed each bank of the river, while another observed facing forward to minimise counting and identification errors.

In addition, local fishermen and villagers were interviewed about the occurrence of Black-bellied Tern and about potential threats to riverine birds such as hunting and the collection of eggs.

RESULTS

Regrettably, the survey programme failed to find any trace of the main target, the Black-bellied Tern, but a total of 75 species of birds was recorded (Table 2) during the work, with 69 on the Jamuna and 49 on the Padma rivers, of which 33 (44%) were residents and 42 (56%) were winter visitors. In the case of the Jamuna River, only 10% of the birds were categorised as common (encountered more than 10 times in a visit) and on the Padma only 4%. Many of the species were encountered less than five times during a visit.

Four species were recorded for the first time on the Padma and Jamuna river systems: Common Shelduck *Tadorna tadorna*, Falcated Duck *Anas falcata*, Eastern Marsh Harrier *Circus spilonotus* and Black-necked Grebe *Podiceps nigricollis*, although all have been previously recorded during winter elsewhere in Bangladesh. Three globally Vulnerable species, Asian Woollyneck *Ciconia episcopus*, Indian Spotted Eagle *Clanga hastata* and Greater Spotted Eagle *Clanga clanga*, and three Near Threatened species, Falcated Duck *Mareca falcata*, River Lapwing *Vanellus duvaucelii* and River Tern *Sterna aurantia*, were recorded during the survey.

Important species accounts

Black-bellied Tern *Sterna acuticauda*

Endangered. Despite the intensive searches the team failed to sight any Black-bellied Terns. However, a group of fishermen claimed to see nesting terns including the Black-bellied Tern (they were shown photographs) near the Jamuna bridge at Sirajganj. None of the *Sterna* sp. was recorded even after several visits to these sites. It is perhaps unwise to conclude that Bangladesh no longer supports the Black-bellied Tern given (a) that large stretches along the Jamuna and Padma rivers still remain unsurveyed, and (b) the opportunistic sighting of a pair of Black-bellied Tern in breeding plumage by A. B. M. S. Alam in January 2011 on the banks of the Jamuna River near Sariakandi, Bogra district, which initiated these searches. However, it is apparent that a sharp decline has taken place since the 1990s and, if the species does still occur, the remaining population must be very small. Further surveys are required to ascertain accurately its status in Bangladesh.

Falcated Duck *Mareca falcata*

Near Threatened. One was seen in a mixed flock of wintering ducks near Dhunat on 30 December 2011 at Rajshahi, Jamuna River. It is considered a rare winter visitor to Bangladesh and occurs mainly in the freshwater wetlands of Barisal, Chittagong, Dhaka and Sylhet divisions (Siddiqui *et al.* 2008). This is the first national record of this species for the Jamuna River and Rajshahi division.

Indian Spot-billed Duck *Anas poecilorhyncha*

At least 12 breeding pairs were seen in March and April 2012 near Shariakandi and Gaibanda. This species was not recorded during the early to mid-winter period, as presumably at that time it was dispersed more widely and only later returned to the rivers to breed. Although it is considered to be an uncommon resident of Bangladesh it is known to occur in all divisions (Siddiqui *et al.* 2008). However, recent observations from several freshwater wetland sites in north-east Bangladesh suggest that the resident population is undergoing a gradual decline, primarily because of collection of eggs by humans and loss of suitable breeding habitat. Breeding records away from the haors in the north-east are scarce, with almost no known recent records. One nest was found in February 2012 at Pashua Haor in the north-east by SUC; unfortunately all seven eggs were later collected by local fishermen. A local fisherman at Shariakandi reported collection of several clutches from grassy chars along the Jamuna River. Hence it is important to note that these moderately undisturbed chars still support breeding populations of this declining species in Bangladesh.

Black-necked Grebe *Podiceps nigricollis*

Four individuals were photographed near Aricha Ghat on 6 February 2012. This is the second record and first photographic evidence of this vagrant in Bangladesh. The first record was among a large concentration of waterfowl on Tanguar Haor (north-east region) on 7 February 2002 (Thompson & Johnson 2003). The four birds observed are possibly the largest group recorded in South Asia.

River Lapwing *Vanellus duvaucelii*

Near Threatened. Only one pair was observed, nesting on a sand-spit in Rajshahi (24.367°N 88.600°E) at 10h00 on 17 April 2012. The scrape nest, which contained three eggs, was found on a 450 m² sandy spit between channels 540–577 m wide. The nest was exposed, surrounded by scattered grass, and was built on the edge of a small sand dune. The incubating River Lapwing (it was not possible to determine the sex) left the nest as the observer approached within 40 m. The other member of the pair was seen foraging, about 190 m from the nest, along the edge of the water. The oval-shaped eggs were pale-brown and heavily dotted with dark

Table 2. Numbers of birds recorded along Jamuna (J) and Padma (P) rivers between December 2011 and April 2012. Sequence follows del Hoyo & Collar (2014) for non-passerines and BirdLife International (2014c) for passerines.

Name	J1	J1	J2	J3	J3	J4	J5	J6	J6	J7	P1	P2	P3	P4	Total
Lesser Whistling-duck <i>Dendrocygna javanica</i>							1								1
Common Shelduck <i>Tadorna tadorna</i>					2			4			2				8
Ruddy Shelduck <i>Tadorna ferruginea</i>	27	17		79		24	25	29			6	1	1		209
Tufted Duck <i>Aythya fuligula</i>				1											1
Garganey <i>Spatula querquedula</i>					2										2
Northern Shoveler <i>Spatula clypeata</i>											2				2
Falcated Duck <i>Mareca falcata</i> (NT)				1											1
Gadwall <i>Mareca strepera</i>			41	99	1	4		230		7	77	3	130		592
Eurasian Wigeon <i>Mareca penelope</i>					2										2
Indian Spot-billed Duck <i>Anas paucilarhyncha</i>					22				7						29
Northern Pintail <i>Anas acuta</i>	120										4	2			126
Little Grebe <i>Tachybaptus ruficollis</i>									2		1				3
Great Crested Grebe <i>Podiceps cristatus</i>	1	1	1	2		2		2			1	3			13
Black-necked Grebe <i>Podiceps nigricollis</i>										4					4
Asian Openbill <i>Anastamus ascitans</i>										5					5
Black Stork <i>Ciconia nigra</i>								8	1		1				10
Asian Woollyneck <i>Ciconia episcopus</i> (VU)	1														1
Indian Pond Heron <i>Ardeala grayii</i>			2	4		1	5	4	3			3			22
Grey Heron <i>Ardea cinerea</i>	7	2	5	3			3	10			5	1	104	1	141
Great Egret <i>Ardea alba</i>	30			2			3				7	2	5		49
Intermediate Egret <i>Ardea intermedia</i>			1			1	3	1				3			9
Little Egret <i>Egretta garzetta</i>	20		2	3			10					3		6	44
Little Cormorant <i>Micracarba niger</i>	23	2	3		13		3		2	40	2				88
Great Cormorant <i>Phalacrocorax carbo</i>			1	2			1	1		11	8				24
Little Ringed Plover <i>Charadrius dubius</i>	5	8	12	7		3	10	9	8		2	4		3	71
Kentish Plover <i>Charadrius alexandrinus</i>				3		2		1			112	3		3	124
Lesser Sandplover <i>Charadrius mangalus</i>	2					5					900	17		2	926
Greater Sandplover <i>Charadrius leschenaultii</i>											50				50
River Lapwing <i>Vanellus duvaucelii</i> (NT)														2	2
Red-wattled Lapwing <i>Vanellus indicus</i>	4	1		1					2	10					18
Curlew Sandpiper <i>Calidris ferruginea</i>		3					2					13	2		20
Temminck's Stint <i>Calidris temminckii</i>							5				17		2		24
Dunlin <i>Calidris alpina</i>							12					2			14
Little Stint <i>Calidris minuta</i>	2	5	7	8			1	11			14			4	52
Common Sandpiper <i>Actitis hypoleucos</i>	4	1	2								2				9
Common Greenshank <i>Tringa nebularia</i>	2	5	2	2	10	3	10	15			14	3			66
Little Pratincole <i>Glareola lactea</i>	115		15		156	93		17	22	10	118	90	11	2	649
Brown-headed Gull <i>Larus brunnicephalus</i>										8				32	40
Black-headed Gull <i>Larus ridibundus</i>	1														1
Little Tern <i>Sternula albifrons</i>					43				5					4	52
Whiskered Tern <i>Chlidonias hybrida</i>					39				11					14	64
River Tern <i>Sterna aurantia</i> (NT)													1		1
Osprey <i>Pandion haliaetus</i>											3	1	1		5
Black-winged Kite <i>Elanus caeruleus</i>	1	1		2			1		2						7
Indian Spotted Eagle <i>Clanga hastata</i> (VU)	1														1
Greater Spotted Eagle <i>Clanga clanga</i> (VU)		1											2		3
Steppe Eagle <i>Aquila nipalensis</i>	1		3								1		1	1	7

Name	J1	J1	J2	J3	J3	J4	J5	J6	J6	J7	P1	P2	P3	P4	Total
Western Marsh Harrier <i>Circus aeruginasus</i>			1	2			1			1					5
Eastern Marsh Harrier <i>Circus spilanatus</i>	1														1
Pied Harrier <i>Circus melanaleucas</i>	1								1						2
Black Kite <i>Milvus migrans</i>	3		2	3	4	1		2		3					18
Eurasian Buzzard <i>Butea butea</i>						1								1	2
Long-legged Buzzard <i>Butea rufinus</i>	1						2	3			8				14
Common Kingfisher <i>Alceda atthis</i>			1				1	2		2		1			7
Pied Kingfisher <i>Ceryle rudis</i>		3	5	4		4		5	5	4	7	6	5	2	50
White-breasted Kingfisher <i>Halcyon smyrnensis</i>			1			1		1		1					4
Common Kestrel <i>Falca tinnunculus</i>		2	1			2		3	1			3		2	14
Peregrine Falcon <i>Falca peregrinus</i>	1														1
Brown Shrike <i>Lanius cristatus</i>				1			2								3
Long-tailed Shrike <i>Lanius schach</i>		1	1			1		1		1					5
Black Drongo <i>Dicrurus macracercus</i>	2		1				3	1				2	3		12
Jungle Crow <i>Corvus leuclantii</i>	1							1							2
Sand Martin <i>Riparia riparia</i>											4				4
Plain Martin <i>Riparia paludicola</i>						22		9	7		5				43
Barn Swallow <i>Hirunda rustica</i>	53					12					5				70
Rufous-winged Lark <i>Mirafra assamica</i>				2											2
Indian Short-toed Lark <i>Calandrella raytal</i>	10	4		5		3	11	1	6		13	2		2	57
Oriental Skylark <i>Alauda gulgula</i>	2					1						1			4
Zitting Cisticola <i>Cisticola juncidis</i>				1			1	1							3
Graceful Prina <i>Prinia gracilis</i>						1	2	1							4
Bank Myna <i>Acridatheres ginginianus</i>				11			1	2	21		4				39
Asian Pied Starling <i>Sturnus cantra</i>	4	2		2		12	5							2	27
White Wagtail <i>Motacilla alba</i>	15	9	18			10		15			6		2	1	76
Citrine Wagtail <i>Motacilla citreola</i>	3			2		1		1				1			8
Yellow Wagtail <i>Motacilla flava</i>			3	1			3	1				1			9
Total	464	68	131	253	294	229	108	392	106	107	1,401	171	270	84	4,078

brown and black spots and blotches. The River Lapwing is considered a rare resident in Bangladesh and listed as nationally Endangered. Currently, it is known to occur mainly along riverbeds in Chittagong, Dhaka and Rajshahi divisions, but it was thought to be extirpated from Sylhet division (IUCN 2000, Siddiqui *et al.* 2008). The River Lapwing was recently sighted in several locations outside the study area, including two birds on the Mahananda River, Tetulia, in September 2010, nine on the Sangu River near Bandarban (south-east) in December 2011 (S. P. Mahood *in litt.* 2012), one on the Piyain River in the Jaflong area, Sylhet division, in April 2012 and a flock of five on the Gorai River near Kushita in June 2012. All these sightings were from rivers which are approximately 200–500 m wide, considerably less than the large, fast-flowing, wide rivers covered in this survey. It seems the River Lapwing prefers stable narrow rivers, tributaries and less dynamic channels adjacent to a wide river. In South-East Asia, especially in Cambodia and Laos, River Lapwing prefers wide riverbeds but narrow rivers in Bangladesh (Duckworth *et al.* 1998, BirdLife International 2014b). The majority of potential River Lapwing habitat, particularly in Rajshahi division, remains unsurveyed.

Little Pratincole *Glareola lactea*

This species was regularly seen on both rivers in relatively good numbers, with a maximum flock of 156 individuals. A chick was found on a sandbank hiding in thin vegetation, 7 km downstream

from Shariakandi, on 22 April 2012. At least 15 pairs were in the area and several were possibly breeding on the same sandbank, even though only the one chick was found.

River Tern *Sterna aurantia*

Near Threatened. Only one was sighted on 8 February 2012 on the Padma River near Hardinge Bridge. The tern was observed for 20 minutes while it was actively foraging. There are only two recent records of this species from inland waters: seven on the Jamuna River near Nagarbarighat in December 2009 and three on a river near Pashua Haor, Sunamganj, in February 2011 (P. Thompson *in litt.* 2011). There are regular records of up to 10 breeding pairs, and several nests were found in January 2009 on Domar Char (22.039°N 91.068°E) adjacent to Hatia Island on the south-central coast, while two pairs (probably breeding) were observed on Sandwip Island (22.400°N 91.532°E) on the south-east coast. Both of these nest sites were located less than 500 m from open sea, and may constitute the first record of nesting River Tern on coastal sand dunes in Bangladesh.

Indian Spotted Eagle *Clanga hastata*

Vulnerable. An adult was seen near Nagarbarighat on 28 December 2011, resting on a sandbank close to the water's edge. It is considered a rare resident of Bangladesh (Siddiqui *et al.* 2008). It may breed in the area but no evidence of this could be gathered.

Greater Spotted Eagle *Clanga clanga*

Vulnerable. An adult was observed soaring over the Jamuna River at Belkuchi (24.283°N 89.700°E) on 5 February 2012. Another two adults were seen soaring over the Padma River near Hardinge Bridge on 8 February 2012. This species is known as a rare winter visitor and occurs mainly in the haors of Bangladesh (Siddiqui *et al.* 2008).

DISCUSSION

Black-bellied Tern

According to BirdLife International (2014a), the Black-bellied Tern was previously common but is now a local breeder in Bangladesh. Apparently, there has been no substantiated breeding record later than 2000. The coastal records from Cox's Bazar (Sykes 2010) should be treated as unreliable (most probably these referred to late winter Whiskered Terns *Chlidonias hybridus*), since recent year-round waterbird surveys in Cox's Bazar have not recorded any Black-bellied Terns (SUC pers. obs. 2012). However, a pair was photographed in full breeding plumage from Sariakandi, Bogra district (24.891°N 89.591°E), on 25 January and 11 February 2011, which confirmed the ongoing presence of this species in Bangladesh, although our extensive targeted survey failed to find the tern.

The widespread sharp decline of this riverine species is believed to be triggered by a combination of several factors throughout its range. A major factor is the destruction of breeding habitat as islands and sand-spits in larger rivers are increasingly cultivated. However, in Bangladesh this appears to be a modest threat, as many islands, sandbanks and sand-spits are still relatively undisturbed, even though the majority of the riverbanks are largely degraded. Other riverine species such as River Lapwing, Little Tern *Sternula albifrons* (although no nests were found, several pairs were sighted during the survey) and Little Pratincole are breeding along the Jamuna and Padma rivers. Moreover, human footprints or evidence of other human activities were not observed on some of these islands and sandbanks, which could provide key breeding habitat for a residual population of the Black-bellied Tern, or for future recolonisation.

The collection of eggs for food might have been a reason for decline at the time when the species bred in large numbers in colonies along the Padma and Jamuna rivers. Several older fishermen indicated that they formerly collected eggs of unidentified species of terns from sandbanks where they could find many nests in one place. Currently, in the absence of the large tern colonies, many of the fishermen or harvesters of other natural resources (grass cutters, farmers and random travellers) collect eggs of Indian Spot-billed Duck from bushy islands; and the eggs of Little Pratincole, Little Tern and River Lapwing from sandbanks. Predation of eggs by predators such as dogs and corvids is unlikely to be a major threat, as no dogs and only one flying Jungle Crow *Corvus leuicollis* was observed on sandbanks during the survey. However, three Black Kites *Milvus migrans* were seen wheeling over the sandbank where the Little Pratincole chick was found.

The Black-bellied Tern primarily feeds on small fish (Rahmani 2012). Since 1960, hundreds of water resource development projects have been implemented in Bangladesh. Through these projects the entire country has been converted into a series of polders with earth embankments. These have resulted in the obstruction of the natural migration and recruitment of fish and other aquatic animals between rivers and their floodplains. The construction and operation of Farrakka Dam in India has changed the water flow regime and hydrology of the entire Padma River basin. The negative impacts of the Farrakka and other barrages has severely affected spawning grounds, nursery areas, and the feeding migrations of fish. Increased fishing pressure has also resulted from upstream river construction of embankments on both banks through the Ganges-Kobadak project (Ali 1997, Mazid 2002, Hussian 2010).

Moreover, flood control structures in the north-west region have also affected fisheries and caused the destruction of many resident breeding stocks of fish. River flows have been altered in both the depth and the duration of flooding, and this has resulted in changes in the pattern of siltation that has had detrimental effects on riverine fishes and prawns. It was estimated that the north-west region's contribution to national fish production fell from 14% in 1983–84 to 10% in 1988–89 and, in particular, riverine fish production decreased from 24,500 tonnes in 1983–84 to 3,940 tonnes in 1988–89. An estimated 2 million ha of floodplain was lost to fisheries due to water development projects by 2005, with a loss of fish production of over 1 million tonnes per year (Ali 1997, Mazid 2002, Hussian 2010). This massive reduction of fisheries in the Jamuna and Padma river systems in Bangladesh clearly might have led to severe food scarcity for the Black-bellied Tern.

Other species

Significant differences in numbers and diversity of other migratory and resident waterbirds were observed between mid-winter and late winter. Resident species such as Little Tern and Indian Spot-billed Duck were not sighted from December to February but were seen in good numbers in March and April on both rivers. These resident species may be wintering in other places and moving to the rivers during the breeding season. Migratory species like Ruddy Shelduck *Tadorna ferruginea* were commonly seen from December to February but were not recorded in March and April. On the other hand Whiskered Tern *Chlidonias hybridus* was recorded in relatively good numbers in March and April but was absent in winter, possibly occurring mainly as a passage migrant on these rivers.

Overall, the numbers and diversity of riverine birds were much higher on the Jamuna River than the Padma, although two significant riverine species—the River Lapwing and the River Tern—were only recorded on the Padma. However, several species that were previously seen on these rivers were not recorded during this survey: Fulvous Whistling Duck *Dendrocygna bicolor*, Greylag Goose *Anser anser*, Greater White-fronted Goose *A. albifrons*, Bar-headed Goose *A. indicus*, Goosander *Mergus merganser*, Red-crested Pochard *Netta rufina*, Common Pochard *Aythya ferina*, Baer's Pochard *A. baeri*, Mallard *Anas platyrhynchos*, Common Teal *A. crecca*, Pacific Golden Plover *Pluvialis fulva*, Grey-headed Lapwing *Vanellus cinereus*, Eurasian Curlew *Numenius arquata*, Green Sandpiper *Tringa ochropus*, Common Redshank *T. totanus*, Wood Sandpiper *T. glareola*, Indian Skimmer *Rynchops albicollis*, Pallas's Gull *Larus ichthyæetus*, Common Gull-billed Tern *Gelochelidon nilotica*, Common Tern *Sterna hirundo* and Eastern Imperial Eagle *Aquila heliaca*.

CONCLUSIONS

Several factors may have affected the numbers of riverine waterbirds. Degradation of the riverine ecosystems has occurred due to the construction of dams and embankments, as well as through agricultural encroachment onto muddy shores (exposed as the water level recedes in the dry season). Moreover, sand and gravel extraction for development is common in these two rivers, especially around large towns. This further stresses the overall riverine ecosystems and reduces potential roosting and nesting habitats of riverine bird species and other resident wildlife. However, even when the habitat remains suitable, hunting in winter by local or visiting sport-hunters and collection of eggs and chicks of sand-nesting birds in late winter are frequent along the Padma and Jamuna rivers. Owing to the reduced level of fisheries resources, competition between riverine birds and local fishermen may also be expected, although there was no evidence of this observed.

Although the survey found no evidence of continued breeding (or even presence) of Black-bellied Tern, the extent of potentially suitable habitat suggests that its presence in small numbers cannot be ruled out. As a consequence we make a number of recommendations which would benefit not only Black-bellied Tern, but also the remaining riverine species in Bangladesh:

- (1) Surveys for the Black-bellied Tern are still needed later in the dry season, ideally between February and May, particularly in Sirajganj (around Jamuna Bridge), the Sariakandi and Kurigram areas of the Jamuna River and the Pabna and Kushtia areas of the Padma River.
- (2) Further surveys are also required to identify breeding sites of other riverine species. Once identified these sites can be declared as sanctuaries. The sandbanks and islands (which remain in state ownership) are not leased out and hence any change in management will not be resisted by leaseholders unlike other wetland sites in Bangladesh.
- (3) There also needs to be a comprehensive conservation strategy by the government for the Padma and Jamuna rivers, with sustainable management plans for fisheries and wildlife.
- (4) An indicator bird species approach, based on those species which are still widespread such as the Little Pratincole, Indian Spot-billed Duck and Plain Martin, should be established to enable rapid assessment of the overall health of the riverine ecosystem.
- (5) Detailed study of the breeding biology of the little known River Lapwing is also recommended to inform any future conservation action plan.
- (6) Almost all the waterfowl species that occur in these areas are protected by the Bangladesh Wildlife Preservation Act. Therefore, enforcement by the government and support by NGOs are needed to tackle bird hunting and prevent illegal habitat encroachment.
- (7) Awareness-raising activities in villages along these rivers should be carried out to educate local people, especially fishermen and other natural resource harvesters, of the importance of birds to maintain a healthy riverine ecosystem.

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